revive the trade demand, and to discuss such questions as to whether portraits may be re-touched or not, and whether the printing of a photograph from a half-dozen negatives, more or less, is to be regarded as a work of design or not.

It is not sufficient to put the names of two or three well-known men of science on the council of a society if the society show no care for science; and if the Photographic Society can do nothing more to merit the nominal position which it holds (without filling it), it is time that it should retire and give place to another. Photography has now become one of the most important aids to research in many fields of Science; every new discovery which shall develop this assistance and make its efficiency more complete is of importance to the whole world—of an importance which makes it almost incredible that the Photographic Society should not only take no part in the investigations which would lead to discovery, but should never even take recognition of them even when made, while the petty jealousies of the dominant clique have driven out of the society most of the really capable and successful investigators who have ever been in it. If the efforts at reform now being made should lead to success and the society become what it should be, a scientific body, so much the better; but if not, it is time that some new organisation should be formed to take in hand seriously the exploration of the still untried fields of chemical research, and make Photography a real branch of Science, and not deal with it merely as an amusement or a trade.

ASTRONOMY IN THE ARGENTINE CONFEDERACY

DR. GOULD, the director of the new Observatory in the Argentine Confederacy, continues to send encouraging accounts of the progress of the great astronomical works that he has there undertaken. Having laboured to determine accurately the relative brightness of all the stars in the southern heavens visible to the naked eye, he announces that a few weeks will enable him to begin the preparation of this work for publication. Great care has been taken to make a thorough and accurate comparison of the results of the four assistants, and the rule has been to determine the brightness of all the stars down to the 7·3 magnitude, in order to make sure of losing none as bright as the seventh.

The labour of the Uranometry was undertaken before the arrival of the large meridian instrument, and as soon as the latter was established (namely, on Sept. 9, 1872), the observations of the zones of all stars as bright as the ninth magnitude were commenced in earnest. Each night three zones are observed whose lengths average about one hundred minutes, the entire observations for the year occupying at least eight hours. The weather is described as having been exceedingly unfavourable for astronomical work during the winter and early spring, until March, April, and May of the present year, when magnificent opportunities were enjoyed. Dr. Gould states that he has observed in all during the past year about fifty thousand stars, and considers that somewhat more than half of the work of observing is already finished.

Astronomers, however, know how great a labour of computation still awaits Dr. Gould and his assistants before his results can be put into that form which is most convenient for use. The photographic work undertaken by him at his own private expense has been prosecuted with all the success that could be expected with a broken lens. Finally, however, he concluded to bespeak another object-glass, which will be purchased for the use of the observatory; and the new lens having arrived in perfect order, he hopes before long to be able to resume his labours under better auspices.

The Cordoba Meteorological Bureau, established at his urgent representation by the national Government, has been organised and brought into working condition as rapidly as was practicable; but as the instruments were necessarily ordered from foreign countries, not more than half of them had arrived at the latest advices. Dr. Gould has, however, had the gratification of finding two gentlemen who have each carried on an uninterrupted series of observations for some dozen years past—one in Buenos Ayres, and the other near the Patagonian frontier—and he has secured the co-operation of about fifteen correspondents. The programme issued for the instruction of his observers differs apparently but little from that of the Smithsonian Institution, the hours of observation being seven, two, and nine, local time.

*THE COMMON FROG**

IX.

THE muscles connected with the human lingual apparatus are sufficiently complex. One such muscle—the *stylohyoid*—passes downwards on each side, from a process of the base of the skull to the corniculum of the os-hyoides

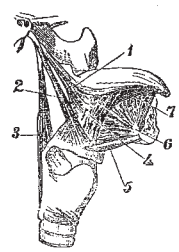


FIG. 63.



FIG. 64.

FIG. 63.—Muscles of the Right Side of the Tongue. 1, stylo-glossus; 2, stylo-hyoid; 3, stylo-pharyngeus; 4, hyo-glossus; 5, genio-hyoid; 6, genio-glossus; 7, lingualis.

FIG. 64.—Head of the Frog *Phyllomedusa*, showing the tongue fixed in front, but free posteriorly.

or tongue-bone. The tongue-bone of the frog is, as we have seen, relatively far greater than is that of man, and the same may be said for the muscles attached to it, since we have no less than four muscles descending from the skull, and implanted into it, on each side.

This fact might well be supposed to bear direct relation to the size and mobility of the frog's tongue. This organ in the frog and toad is singularly different from the tongues of most familiar animals, in that it is not free and moveable in front, but *behind*. These Batrachians take their food by suddenly throwing forwards, out of the mouth, the free hinder end of the tongue. The insect or other small animal struck by it, adheres to it, on account of a viscid saliva with which it is coated. The prey is then suddenly drawn into the mouth and swallowed.

Here then is a ready explanation of the development of the *os-hyoides* and its muscles. There is a difficulty however in that two toads already described, the Pipa and the African form *Dactylethra* (Figs. 11 and 12), have no tongue whatever.

Moreover, there is another toad (*Rhinophrynus*) which is even more exceptional in its order than these two; in that its tongue is not free behind, but, like that of ordinary vertebrates, in front (Fig. 13.)

The fact is, that the large tongue-bone of these animals serves, with the muscles attached to it, as much to facilitate respiration as nutrition.

It has already been said that the frog has no ribs by the elevation and depression of which it may alternately fill and empty its lungs. Neither does it possess that transverse muscular partition, the diaphragm, or midrif, which in man's class is the main agent in carrying on that function.

The lungs of the frog are inflated as follows:—The

* Continued from p. 189.

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mouth is filled with air through the nostrils and kept shut while the internal openings of the nostrils are stopped by the tongue, and the entrance to the gullet is closed. Then, by the contraction of the muscles attached to it, the os-hyoides is elevated ; and every other exit from the mouth being closed, except that leading to the larynx, air is thus driven down the glottis into the lungs.

Thus for pulmonary respiration it is necessary to the frog to keep the mouth shut ; and in this way, but for the action of the skin, the animal might be choked by keeping its mouth open.

It has been already stated that the typical segmentation of the limbs is wanting in all fishes, but present in all Batrachians that have limbs at all. Similarly in all Batrachians that have limbs at all the muscles of those limbs have essentially and fundamentally the same arrangement as in higher animals. In the higher animals, as in man, the muscles of the limbs belong to different categories named from the kinds of motion to which their contractions give rise.

Thus, when two bones are united by a moveable joint (as the thigh-bone and shin-bone) muscles which, by their contraction, tend to make the angle formed by such bones

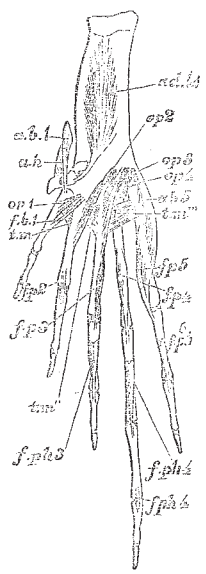


FIG. 65.—Deep muscles of exor surface of Frog's hind foot. (The numbers indicate the digits to which the muscles belong.—No. 1 indicating the first digit or great toe). *ab*, abductors ; *ad*, adductor ; *fb*, flexor brevis ; *fp*, flexores profundi ; *fph*, flexores phalangium ; *op*, opponens muscles ; *tm*, transverse muscles.

acute are termed "flexors." Those, on the contrary, which tend to open out such an angle are termed "extensors."

In the forearm of man, and allied animals, there are muscles which tend by their contraction to place the hand in a position either of *pronation* or of *supination*.

When the arm and hand hang down, the *palm* being directed forwards, the position is that of supination, and the bones of the forearm are situate side by side.

When the arm and hand hang down, but the *back* of the hand is turned forwards, the position is that of pronation, and the radius crosses over the ulna. When we rest on the hands and knees, with the palms to the ground, the forearms are in pronation.

Muscles which tend to place the forearm and hand in the position of pronation are termed *pronators ;* those which, by their contraction, tend to render it supine are called *supinators*.

It is somewhat surprising to find in an animal so nearly related to fishes as *Menobronchus* definite flexors, extensors, pro- and supi-nators essentially like those of higher animals ; and these distinctions once established, persist up to man himself with increasing complications.

The muscular conformity between the highest and lowest of typically-limbed vertebrates is strikingly shown by the structure of the thigh and leg, the leading muscles of these parts in the frog being so like those of man that the practice of calling them by the same name is abundantly justified.

The perfection of man's hand has been justly the theme of panegyric, esteemed as widely as it is known. The delicacy and multiplicity of the motions of which it is capable are of course greatly due to the number and arrangement of the muscles with which it is provided.

One of the most important of these motions is that of the thumb as placed in opposition to the fingers, and effected by a muscle termed *opponens pollicis*.

An "opponens" muscle is one which passes from the bones of the wrist to one or other of the bones of the middle of the hand called *metacarpals*, and the *opponens pollicis* passes of course, as its name implies, to the metacarpal of the pollex or thumb.

No other finger of man's hand is furnished with such a muscle except the little finger, which possesses an *opponens minimi digiti*, passing from the wrist to the fifth metacarpal. The same condition obtains in the apes, though in them the opponens of the thumb is smaller and weaker than in man. Though the foot of man is furnished with many muscles, like the hand, yet not one of the toes is provided with an "opponens" or muscle, passing from the bones of the ankle to one or other of the bones of the middle of the foot, which latter are called metatarsals. The same is the case with the apes, except that the Orang-utan has a small "opponens" attached to the great toe.

This being premised, the foot of the Frog may well excite surprise as to its rich muscular structure. In addition to very numerous other muscles on both surfaces every one of the toes is provided with a separate opponens muscle, each having a muscle which passes from the bones of the ankle to its middle foot bone or metatarsal.

The question naturally occurs on beholding this prodigality of muscles—What special purpose is served by the Frog's foot? Surely mere jumping and swimming cannot require so elaborate an apparatus.

In fact, however, the Frog *does* make use of his feet for a purpose requiring actions no less dexterous and delicate than nest-building.

In 1872 Dr. Günther observed a Frog busily occupied, and industriously moving its hind legs in a singular manner. On approaching closely he found it had constructed for itself a shelter in the shape of a little bower, constructed of dexterously interwoven blades of grass. The circumstances have been kindly transmitted to the author by the observer in a private letter, as follows :—

"The 'nest-building' Frog was a large example of *Rana temporaria*, or *esculenta* (I forget which), which I had brought into the garden behind my house. It had taken up its abode in grass, near the edge of a tank, from which the turf sloped abruptly to the level of the garden. When I first disturbed the Frog from its lair, I found that it had lain in a kind of nest, which I cannot better describe than by comparing it to the form of a hare, with the grass on the edges so arranged that it formed a sort of roof over it. Sometimes the animal returned to it, sometimes it prepared a new form close to the old one, which remained visible for several days until it was obliterated by the growing grass.

"When in its nest, nothing could be seen of the Frog but the head.

"One day I poked the Frog out of its lair ; after two or three jumps it returned to the old spot, and, squatting down on the grass, by some rapid movements of the hind legs it gathered the grass nearest to it, pressing it to

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its sides, and bending it over its body so as to be partially hidden.

"In all these operations no material was collected by the animal for its nest, but only the growing grass was either pressed down, or arranged so as to form a complete retreat.

"Unfortunately, the Frog soon disappeared altogether."

It is very probable that other functions, as yet unnoticed, may be performed by these members, since though the observation just above related is the first known observation of the kind, yet the manœuvre recorded is no doubt a constant habit of the animal.

Doubtless, also, the very singular actions performed by the male *Pipa* and *Obstetricans* are performed by the help of the hinder extremities.

At the same time that the Frog shows so startling a resemblance in its leg muscles to higher animals, it shows

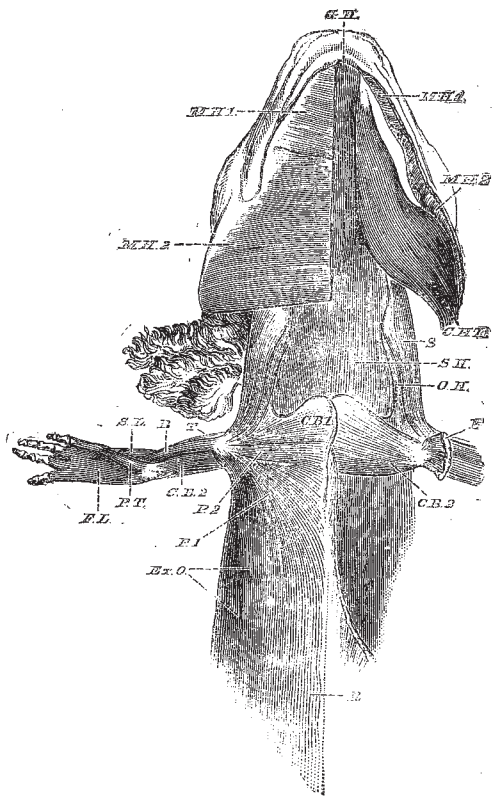


FIG. 65.—Muscles of Ventral Surface of *Menobranchus*. On the right side, superficial muscles; on the left side, deeper muscles, the mylo-hyoidei, pectoralis, and external oblique being removed. Also superficial flexor muscles of right pectoral limb of *Menobranchus*. *B*, biceps; CB^1 and CB^2, coraco-brachialis; *CHE*, cerato-hyoideus externus; *EO*, external oblique; *FL*, flexor longus; *GH*, genio-hyoid; MH^1 and MH^2, mylo-hyoideus; *OH*, omo-hyoid; *P*, P^1, and P^2, pectoralis; *R*, rectus; *S*, subclavius; *SH*, sterno-hyoid; *SL*, supinator longus; *T*, triceps.

as striking a difference from the leg muscles of animals with which it is nearly allied,—namely, with those of its class-fellows, the *Urodela*.

In Reptiles we meet with a muscle which takes origin from beneath the joints of the tail, and is inserted with the thigh-bone, and which has no certain representation amongst mammals, and is called the *femoro-caudal*.

In the Urodela we also meet with a *femoro-caudal*, but no such structure exists in the Anoura. This is not so surprising when we recollect the abortive condition of the tail of the Frog. It might, however, have been expected that in the Tadpole, during the co-existence of the tai with the hind legs, and while it thus externally resemble an eft—such a muscle would transitorily exist. Such, however, is not the case, and the distinction is a very remarkable one.

In one point, however, the Efts resemble the Frogs, namely, in the greater number and greater complexity as well as the greater size of the muscles of the hind-limbs than of the fore-limbs. It is well known that the Efts

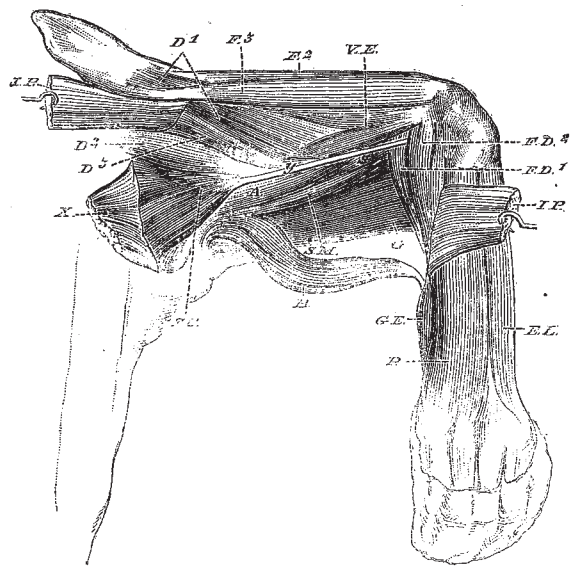


FIG. 67.—Deeper Muscles of Outer Aspect of Right Pelvic Limb of Parson's Chameleon; the ilio-peroneal cut reflected. *A*, adductor; *B*, biceps; D^1, gluteus primus; D^2, gluteus secundus; D^3, gluteus tertius; *EL*, extensor longus digitorum; F^2 and F^3, rectus femoris; *FC*, femoro-caudal; FD^1, flexor longus digitorum; FD^2, flexor tertius digitorum; *G*, gracilis; *GE*, gastrocnemius externus; *IP*, ilio-peroneal; *P*, peroneus; *S*, tibial adductor; *SM*, semi-membranosus; *VE*, vastus externus; *X*, gluteus maximus; *y*, tendon of femoro-caudal.

make use of their hind-limbs in attaching their eggs to the leaves and branches of aquatic plants; and further observations may show with regard to these animals facts as to

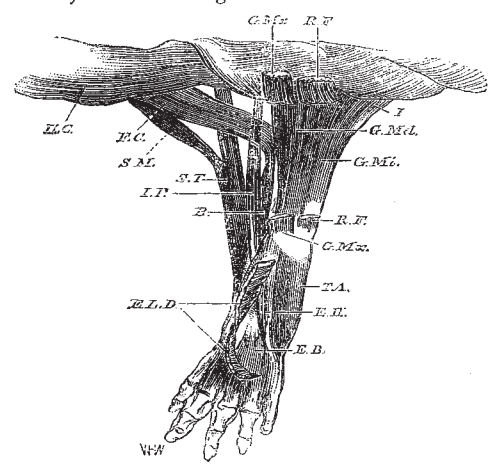


FIG. 68.—Deeper Muscles of Extensor Surface of Right Leg of Menopoma. *B*, biceps; *EB*, extensor brevis; *EH*, extensor hallucis; *ELD*, extensor longus digitorum; *FC*, femoro-caudal; *GMd* and *GMi*, muscles like the lesser glutei; *GMx* and *RF*, great extensors of the thigh; *I*, muscle resembling the iliacus; *IIC*, ilio-caudal; *IP*, ilio-peroneal; *SM* and *ST*, muscles like the semi-membranosus and semi-tendinosus respectively; *TA*, tibialis anticus.

the use of the members, as novel and interesting as the one just cited with regard to the nest-building actions of the Frog.

ST. GEORGE MIVART

(*To be continued.*)

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